BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : C23C 8/04, E21B 17/00

A1

(11) International Publication Number: WO 99/13125

(43) International Publication Date: 18 March 1999 (18.03.99)

(21) International Application Number: PCT/SE98/01525

(22) International Filing Date: 26 August 1998 (26.08.98)

(30) Priority Data:
9703262-7 10 September 1997 (10.09.97) SE

(71) Applicant: SANDVIK AB [SE/SE]; S-811 81 Sandviken (SE).

(72) Inventor: LUNDELL, Lars-Gunnar; Urangatan 13, S-811 52 Sandviken (SE).

(74) Agent: CARLSSON, Lars-Åke; Sandvik AB, Patent Dept., S-811 81 Sandviken (SE).

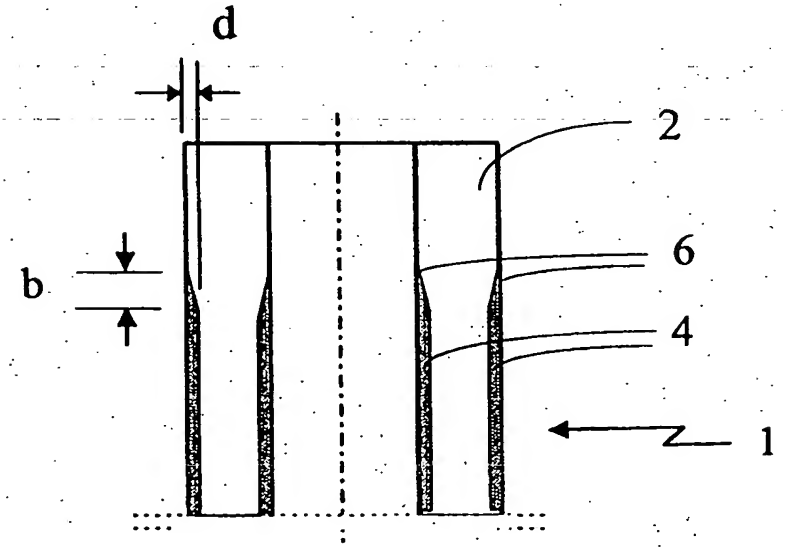
(81) Designated States: AU, BR, CA, CN, JP, MX, PL, RU, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: A DEVICE, A DRILL MEMBER AND A METHOD FOR MASKING THE MEMBER AT THERMO CHEMICAL SURFACE TREATMENT

(57) Abstract

The present invention relates to a device, a drill member and a method for masking the member at thermo chemical surface treatment. The drill member (1) such as a drill tube or a drill rod, has a substantially elongated basic shape and at least one free end (2) as well as a central channel for flush medium. Hardened portions (4) with a first case depth (d) are provided at least partly at the jacket surface of the member. Not hardened portions are provided at least partly at said free end (2), wherein a transition zone (6) in the longitudinal direction between hardened and not hardened material have a first length (b). The first length (b) of the transition zone (6) is longer than the first case depth (d).



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

A device, a drill member and a method for masking the member at thermo chemical surface treatment

The field of the invention

The present invention relates to a device, a drill member and a method for masking the member at thermo chemical surface treatment according to the preambles of respective independent claims.

Technical background

At thermo chemical surface treatment such as carburizing, nitrocarburization, boriding etc. is sometimes required that certain surfaces shall maintain the same chemical composition as before the heat treatment. Normally, this happens by covering these surfaces with some preparation which prevents the steel surface from being directly exposed to the furnace atmosphere. The coating forms a more or less diffusion sealed layer for elements in the furnace atmosphere which is not in equilibrium with steel. The coating can be done in a number of ways such as by brushing, dipping, spraying of fluid coating, sticking of pastes or by electrolytic copper coating. At for example carburizing of tubes one wishes that the ends and about 20 mm along the tube are not carburized, neither internally nor externally, a usual method is to dip the tube end in color which then may dry under increased temperature. For the layer to be dense drops must not be formed and the layer must not be too thin. Therefore often an adjustment must be done with a brush or with another tool after the dipping for smoothing the layer. The method is expensive since it requires large exactness both with regards to color (viscosity, composition etc.) and the applying. Fig. 1 shows an example of a drill member or a tube 1 which has been covered with a protective coating in a conventional manner through dipping of the end 2. The protective coating is applied at the end surface and along a part of the surface of the tube and somewhat down at the inside according to markings in Fig. 1. Arrows depict the motion of the furnace atmosphere on the surfaces. Fig. 3 shows an example of a carburized tube 1 which has been painted at the end surface 2 before carburizing.

The carburized layer which has a depth often about 1 mm obtains a relatively abrupt transition 5 where the painted surface starts. The transition zone length is marked by the letter a, often about 1 mm. The abruptness of the transition 5 can be calculated by dividing the transition zone length with the depth, i.e. a/d. Thereby the abruptness amounts to about 1 at the conventional method for heat-treatment such as disclosed in for example US-A-4,165,243. The abrupt transition provides unfavorable states of strain in the surface for example if the tube or the rod is submitted to bending or impact stresses. A thermo chemical treatment of a down-the-hole drill bit is described in US-A-4,867,015, wherein the insert holes in the drill bit are covered with paint before the heat-treatment is started.

Objects of the invention

One object of the present invention is to provide a method for masking a member at thermo chemical surface treatment in a simple and thereby cost-effective manner.

Another object of the present invention is to provide a method for masking a member at thermo chemical surface treatment for improving the strength of the member.

Still another object of the present invention is to provide a drill member with successively varying case depth.

Still another object of the present invention is to provide a device which enables control of the case depth.

Description of the figures

Fig. 1 shows an example, in a perspective view, of a drill member covered with protective coating in a conventional manner through dipping. Fig. 2 shows a device according to the present invention in a sectioned side view. Fig. 3 shows an example of a drill member, in cross section, after conventional painting at one end and carburizing. Fig. 4 shows an example of a drill member according to the present invention, in cross-section, after carburizing. Fig. 5 shows an alternative embodiment of a device according to the present invention in a

sectioned side view. Fig. 6 shows an example of an alternative embodiment of a drill member according to the present invention, in cross-section, after carburizing.

Detailed description of the invention

Fig. 2 shows a device or a lid 3, of for example ceramics or steel, for counteracting thermo chemical effect of a steel surface 14. The steel surface is preferably provided on a tube- or rod end 2 to be used for percussive drilling. The device has a rotation symmetrical tubular outer wall or external lid part 11 and a rotation symmetrical tubular internal wall or inner lid part 12. The inner and external walls 12, 11 are connected by a ring-shaped wall portion 13 at one end surface such that a circular recess 15 is formed for receiving of a tube 1 end. The internal diameter of the outer wall 11 and the outer diameter of the internal wall 12 shall be dimensioned such that the gap opening 7 relative to the tube 1 which is to be protected against thermo chemical treatment does not become larger than 0,1 mm. The lid is mounted at the tube 1 end 2 during the heat-treatment. Arrows depict the motion of the furnace atmosphere about the surfaces.

Fig. 4 shows an example of a carburized tube 1 which has been protected against carburizing at the tube end (externally and internally) by the aid of a lid according to the present invention. The lid covers both the end surface 14 and the connecting part of the envelope surface. The carburized layer has an elongated and continuous transition zone 6 between the carburized layer and the untreated end surface 2. The transition zone length is depicted by the letter b. The transition zone length b of the thermo chemically treated surface is longer, preferably more than double the case depth d, than the transition zone length which is obtained at other protective methods such as dipping, painting, etc. The external lid part 11 and the internal lid part 12 have the same length and thereby gives just as long protected area at the inside and outside surfaces, respectively, of the tube 1. By the expression "not carburized" and similar expressions, is here meant that the surface may have a negligible increase of carbon, which substantially does not influence the result of the heat treatment.

Fig. 5 shows an alternative embodiment of a device or lid 3' according to the present invention. The device 3' has chamfered exits 7' both externally and internally, wherein the transition between the carburized layer 4' of the carburized part of the tube 1' and the not carburized surface of the tube end 2' becomes longer. This is shown in Fig. 6 where the transition zone length is depicted by the letter c. The length of the transition zone can be adjusted by more or less chamfering of the internal diameter of the external lid part and likewise chamfering of the outer diameter of the internal wall of the device 3'.

At comparison of the three different variants described above the following relationship of the transition zone lengths for the carburizing layers applies $a < b < c$.

The protective lid 3 is developed to fit into a rotation symmetrical tube- or rod end. The object is that the lid shall have sufficient fit such that the furnace atmosphere will not enter too far along the part of the tube wall which is protected against thermo chemical treatment such as for example carburizing. Normally, it is sufficient with a gap of $\leq 0{,}1$ mm if there simultaneously is abutment between the end surface of the tube end and the bottom of the lid.

By chamfering the lid, such as is shown in Figure 5, with chamfers 7' the gap opening is increased. Thereby the transition zone 6' for example for the carburizing layer can be made even longer, with length c, than with a gap opening with a constant width. In this manner favorable tensions in the transition are obtained for example when the tube or rod is submitted to bending stresses.

Alternatively the external lid part 11 and the internal lid part 12 have different lengths and thereby give differently extended protected areas at the internal and external surfaces of the tube 1. Likewise the internal diameter at 10 of the inner lid part can be reduced such that the thermo chemical effect at the inside of the tube 1 becomes less than at the tube surface.

The lid must be made of a material which do not influence the composition in the tube surface. Preferably a ceramic material or a steel is used which has a composition which is balanced with respect to the steel in the tube.

The lid is placed either on top of the standing tube ends such that the lid falls down by its own weight against the tube end surface or the tube can be positioned on the lid. The hole through the lid entails that the thermo chemical treatment is also obtained at the inside of the tube on the surfaces which internally is not protected by the lid. By making a small hole in the lid the carburizing depth inside on the unprotected surfaces can be made less than at the external unprotected surfaces.

The method relates to applying a lid on the part of the tube which is not to be thermo chemically treated. The method for masking a drill member at thermo chemical surface treatment, such as carburizing or nitriding comprises the following steps: providing a drill member such as a drill tube or a drill rod, said member having a substantially elongated basic shape and at least one free end and a central channel for flush medium, providing a lid which is substantially geometrically adapted to the free end of the member, bring the lid and the free end of the member to abutment against each other, place the lid and the member in a furnace having a suitable furnace atmosphere and a suitable temperature for heat-treatment of metal, allow the furnace atmosphere to partly enter in between the lid and the member such that the heat-treatment is successively reduced in direction towards the free end surface and such that the transition zone becomes elongated, and cool the lid and the member to ambient temperature and remove the lid from the member. Then the drill member is adapted to be friction welded to a threaded part or a drill bit for percussive drilling.

There are several advantages with this method, such as quick applying and removal of the protection, good reproducability of the protective effect, possibility to vary the transition between the thermo chemically treated surface and the untreated surface, possibility to vary the thermo chemical treatment at the inside of the tube and possibility to control the length and the appearance of the transition.

Claims

1. Method for masking a drill member at thermo chemical surface treatment, such as carburizing or nitriding, said method comprising the following steps:
- providing a drill member (1;1') for percussive drilling, such as a drill tube or a drill rod, said member having a substantially elongated basic shape and at least one free end (2;2') and a central channel for flush medium,
- providing a lid (3;3') which is substantially geometrically adapted to the free end (2;2') of the member,
-bringing the lid and the free end of the member (2;2') to abutment against each other,
-placing the lid and the member in a furnace having suitable furnace atmosphere and suitable temperature for heat-treatment of metal,
-allowing the furnace atmosphere to partly enter in between the lid and the member such that the heat-treatment is successively reduced in direction towards the free end surface (2;2') and such that the transition zone becomes elongated,
-cooling the lid and the member to ambient temperature and
-removing the lid from the member.

2. Method according to claim 1,
characterized in that the following further step is made:
-friction welding the member to a threaded part or a drill bit.

3. Drill member for percussive drilling such as a drill tube or a drill rod manufactured according to the method described in claim 1, said member (1;1') having a substantially elongated basic form and at least one free end (2;2') and a central channel for flush medium, wherein hardened portions (4) with a first case depth (d) are provided at least partly on the jacket surface of the member, wherein not hardened portions are provided at least partly at said free end (2;2'), wherein a transition zone (6;6') in the longitudinal direction between hardened and not hardened material have a first length (b,c),

characterized in that the first length (b,c) of the transition zone (6;6') is longer than the first case depth (d).

4. Drill member according to claim 3,
characterized in that the first length (b,c) of the transition zone (6;6') is at least double as the first case depth (d).

5. Drill member according to claim 3 or 4,
characterized in that it is tube- or rod-shaped.

6. Drill member according to claim 3, 4 or 5,
characterized in that the free end surface is connected to a threaded part or a drill bit by a friction weld.

7. Device for protecting metal surfaces from thermo chemical effect, said device (3;3') being intended to be provided at an end of an elongated drill member for percussive drilling,
characterized in that the device (3;3') comprises a recess (15) which is bordered by at least one radially external wall (11) dimensioned in relation to the drill member such that in use it allows furnace atmosphere to partly enter in between the recess (15) and the member such to create an elongated transition zone in the drill member.

8. Device according to claim 7,
characterized in that the device (3;3') comprises a central hole (10) and a radially inner wall (12).

9. Device according to claim 7 or 8,
characterized in that the radially external wall (11) and/or the radially inner wall (12) comprises chamfered portions (7').

10. Device according to claim 7, 8 or 9,

characterized in that the device (3;3') is rotation symmetrical and forms a tubular outer wall and a rotation symmetrical tubular internal wall, which are connected by a ring-shaped wall portion (13) at one end surface.

Fig. 1 (PRIOR ART)

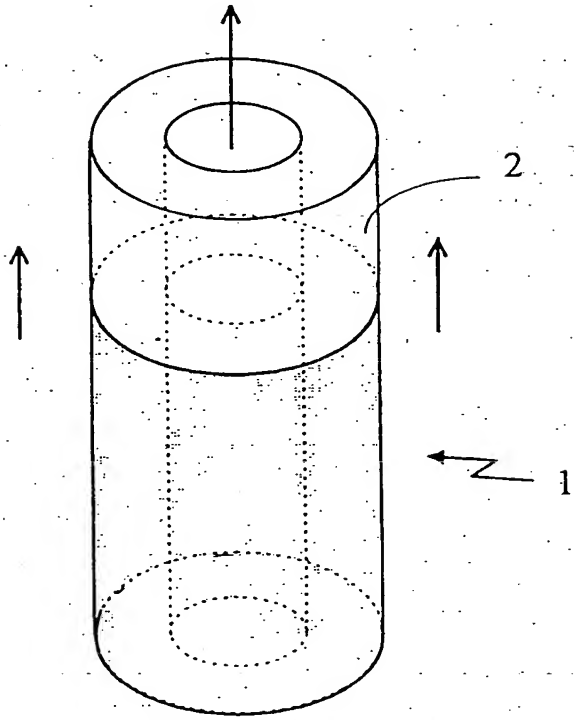
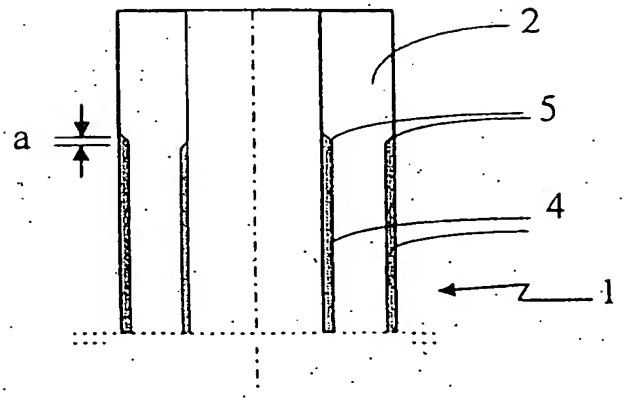


Fig. 3 (PRIOR ART)



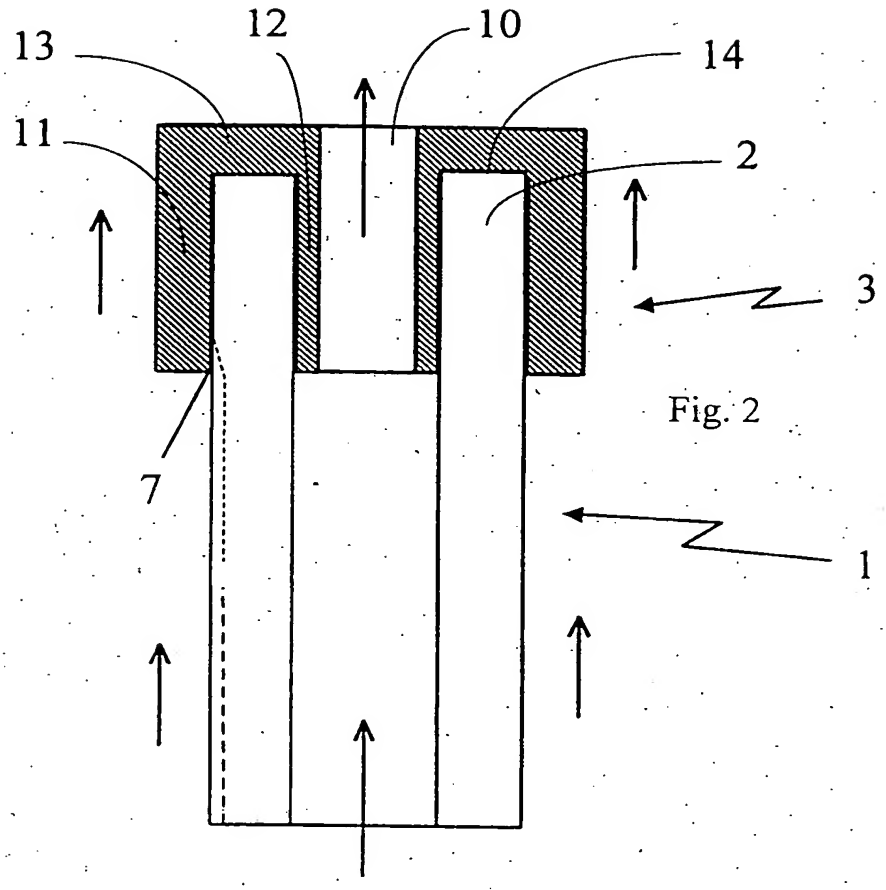
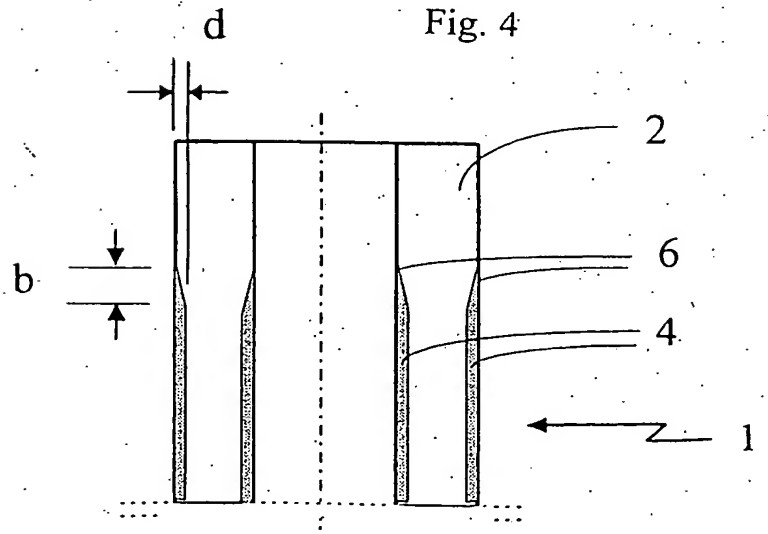


Fig. 2

Fig. 4



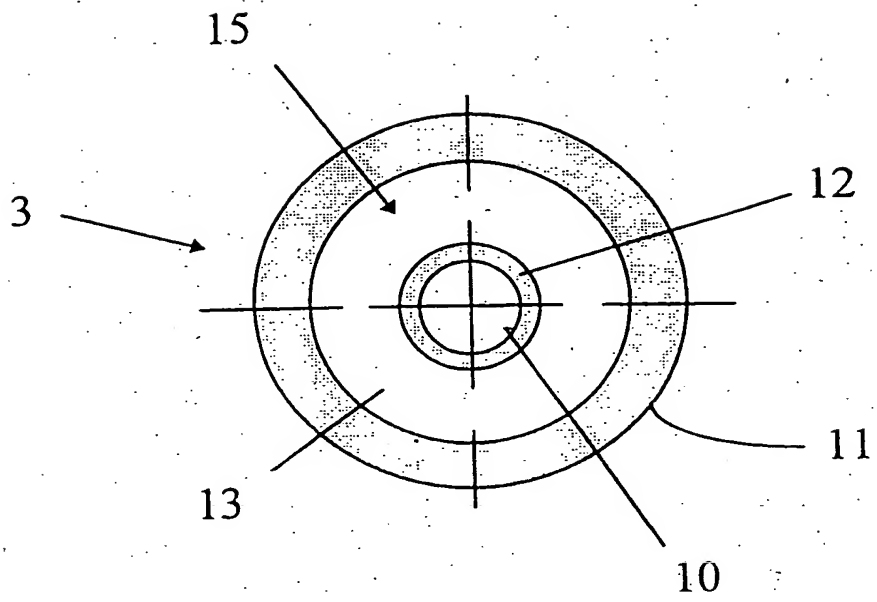


Fig. 2 B

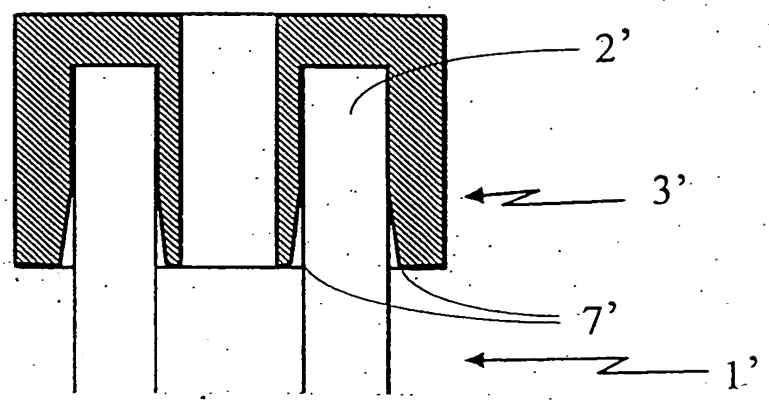


Fig. 5

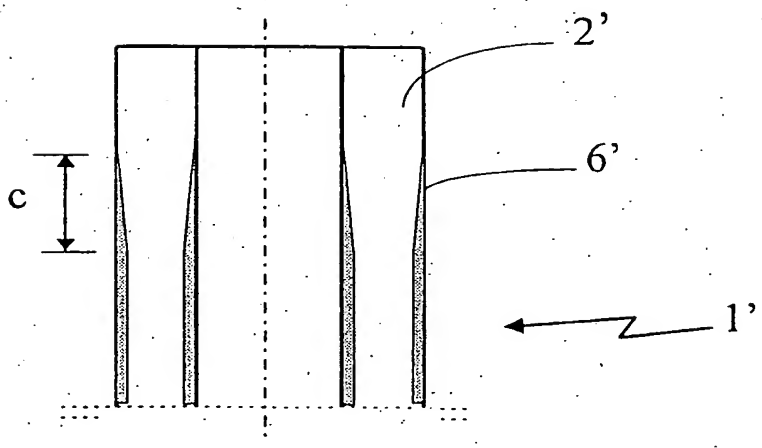


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 98/01525

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: C23C 8/04, E21B 17/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: C23C, C21D, E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EDOC, JAPIO

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4165243 A (MYRON C. SARNES ET AL), 21 August 1979 (21.08.79), column 4, line 28 - line 38; column 6, line 38 - column 10, line 16, figures 5,6 --	1-10
A	WO 9727022 A1 (SANDVIK AB (PUBL)), 31 July 1997 (31.07.97), page 4, line 24 - page 5, line 8, claims 3,4, abstract --	2,6
A	DE 3502144 A1 (NIPPON PISTON RING CO., LTD.), 8 August 1985 (08.08.85), page 5, line 36 - page 7, line 35, claims 1,4, abstract --	1-10

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 December 1998	11 -12- 1998
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Ingrid Grundfelt Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 98/01525

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4279528 A (JACQUES MANGIAVACCHI ET AL), 21 July 1981 (21.07.81), column 2, line 8 - line 44, abstract -- --------	1-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

03/11/98

International application No.
PCT/SE 98/01525

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4165243 A	21/08/79	CA 1114208 A	15/12/81
		DE 2920719 A,C	06/12/79
		FR 2427156 A,B	28/12/79
		GB 2021984 A,B	12/12/79
		IN 152058 A	08/10/83
		JP 1078720 C	25/12/81
		JP 55021583 A	15/02/80
		JP 56020323 B	13/05/81
		SE 448071 B,C	19/01/87
		SE 7904745 A	01/12/79
WO 9727022 A1	31/07/97	AU 1562197 A	20/08/97
		SE 506178 C	17/11/97
		SE 9600217 A	23/07/97
DE 3502144 A1	08/08/85	JP 60152668 A	10/08/85
US 4279528 A	21/07/81	DE 2937323 A,C	20/03/80
		FR 2436282 A,B	11/04/80
		GB 2036251 A,B	25/06/80
		JP 1054574 B	20/11/89
		JP 1581366 C	11/10/90
		JP 55040399 A	21/03/80
		SU 1009284 A	30/03/83